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FINAL TECHNICAL REPORT FOR NAG 5-6920

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Title of Research: Investigating the Extraordinary X-Ray Variability
of the Infrared Quasar IRAS 13349+2439

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Final Report for NASA Grant NAG 5-6920 (XTE)

Investigating the Extraordinary X-ray Variability of the Infrared Quasar IRAS 13349+2439

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ABSTRACT: We observed the luminous quasar IRAS 13349+2439 using RXTE in order to search for rapid variability. Unfortunately, the source was in a low state during the observation (PCA count rate $\sim 1 - 2$ counts/s). It was therefore somewhat weak for RXTE and detailed analysis proved to be difficult.

REPORT:

Improvements in Background Model, Response and Analysis Software for RXTE: Previous to 1998, the background model for the *RXTE* Proportional Counter Array (PCA) did not provide an acceptable subtraction for faint sources such as AGN. An intensive study of this problem was carried out at the *RXTE* Guest observer facility from April to October 1998. The result was the new L7 background model. This model uses a sum of count rates from 7 detectors which have adjacent anodes to predict the rate in the top and mid layers. Another ingredient is count rate in the HEXTE particle monitor which is used to estimate the radiation dosage from the South Atlantic Anomaly (SAA) and modeled with a 240 minute half-life. Essential to this model is the assumption that no flux from the object can be detected in the bottom layer at low energies. Thus this background model can only be applied to objects with count rates $< 40 \text{ counts s}^{-1}$. This background model performs the best when data taken during the 30 minute interval after emergence from SAA passage are discarded, and when data taken when electron rate housekeeping parameter electronm greater than 0.1 are discarded.

The response matrix has also been improved recently. Now, response matrices are constructed for each observation. This makes it possible to account for two time-dependent effects: the slow drift in gain of approximately 1% over two years, and a slowly increasing xenon fraction in the propane layer. Application of this new response improved the spectra, especially in the 10–20 keV range where the flux is low and there is a lot of structure in the background.

Another property that has recently been improved is a better estimation of the uncertainty associated with the background. Previously, the statistics of the background reflected the length of the observation. However, the background model is constructed from many background observations, the total length of which is very much longer than a single observation. Therefore, the uncertainties in the background spectra should be reduced to reflect this fact. A script to correct the background spectra was developed.

An improvement to the data analysis software has also recently been made with the addition of the *REX* script. This script permits analysis of a large number of observations to be done in a nearly automatic, hands-off manor. The use of this script permits analysis of AGN monitoring observations to be done quickly and easily.

IRAS 13349+2438: The data were analyzed by myself and Joachim Siebert in May 1998 using the new L7 background model. Several figures are included showing the results of the analysis. Our conclusion was that unfortunately IRAS 13349+2438 was in a rather low state when the observation took place and it was somewhat weak to be effectively observed using RXTE. The systematic residuals in the spectrum were likely due to inaccurate background subtraction.

FIGURE CAPTIONS:

Figure 1: Lightcurve from the IRAS 13349+2438 observation. The top panel shows the source plus the background, the middle panel shows the modeled background and the bottom panel shows the net light source light curve.

Figure 2: A simple power law fit to the top layer net source spectrum. The photon index is 2.21 which is consistent with that observed from the *ASCA* observation. Systematic residuals are seen between 4 and 7 keV.

Figure 3: When a Gaussian line component is added to the model, the fit is improved. However, the width of the line and equivalent width are inconsistent with the *ASCA* spectrum. Given the very low count rate, the spectral residuals are thought to be likely to be due to inaccurate background modeling.

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IRAS_13349+2438

Bin time: 183.0 s

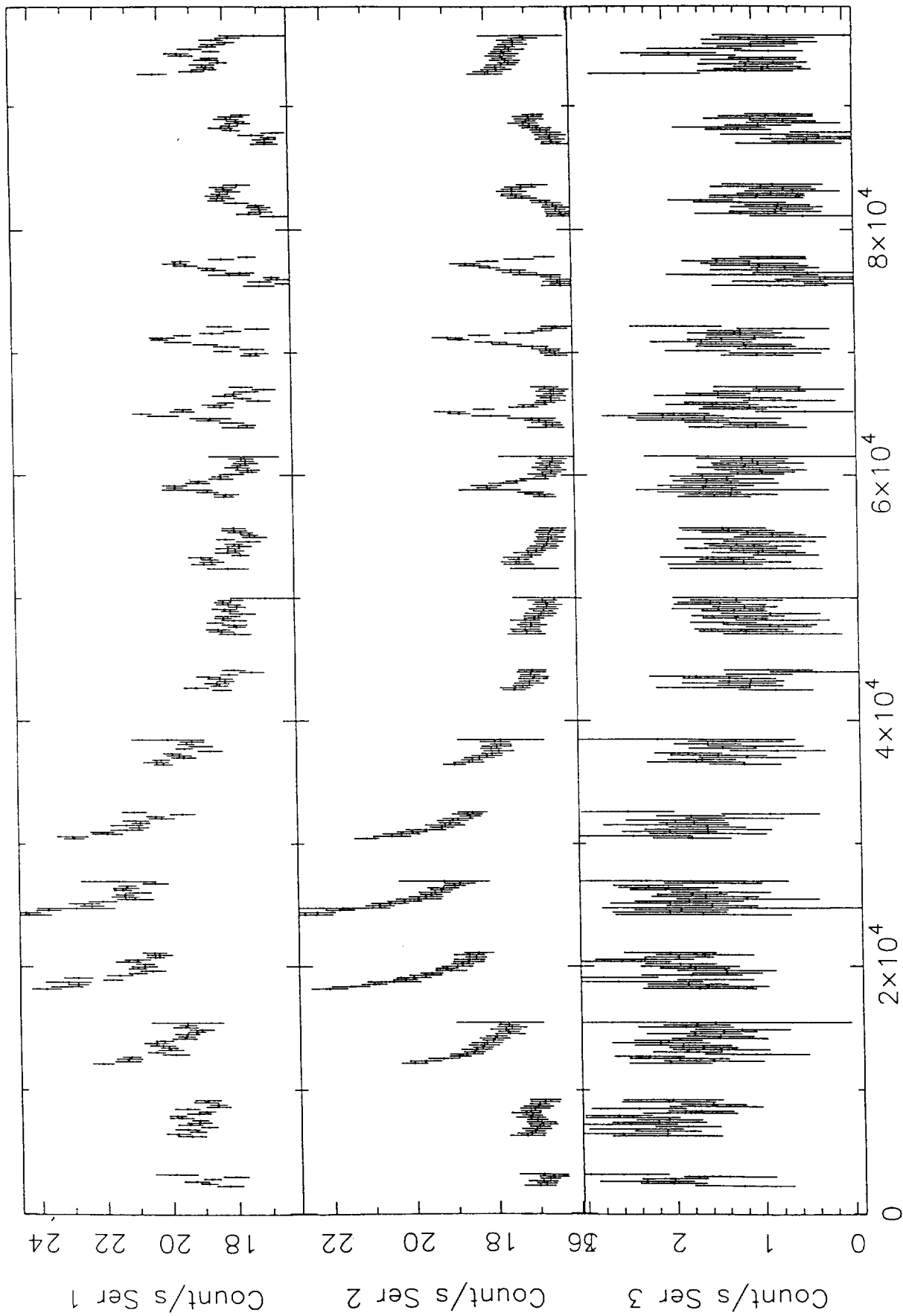


Figure 1

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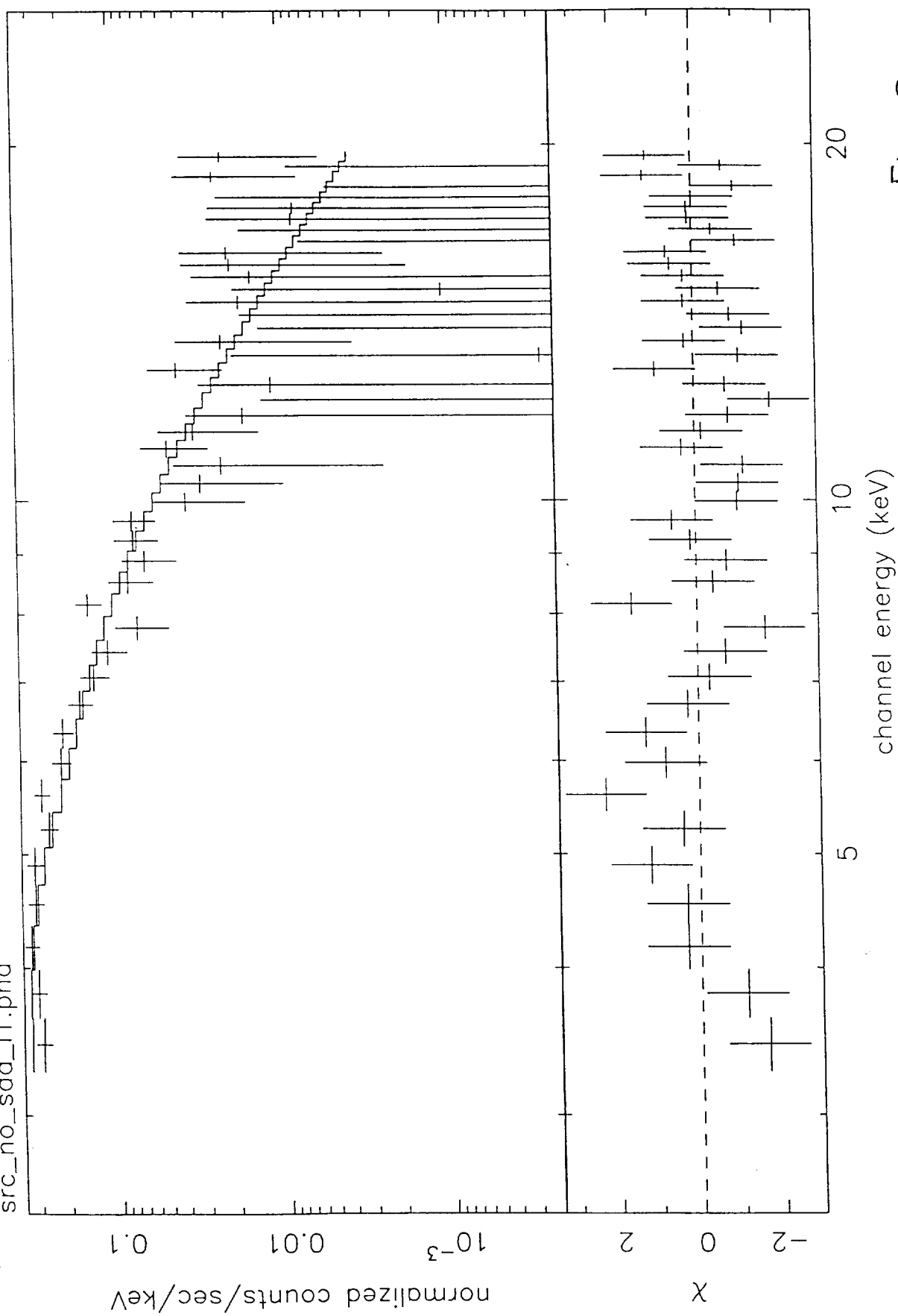


Figure 2

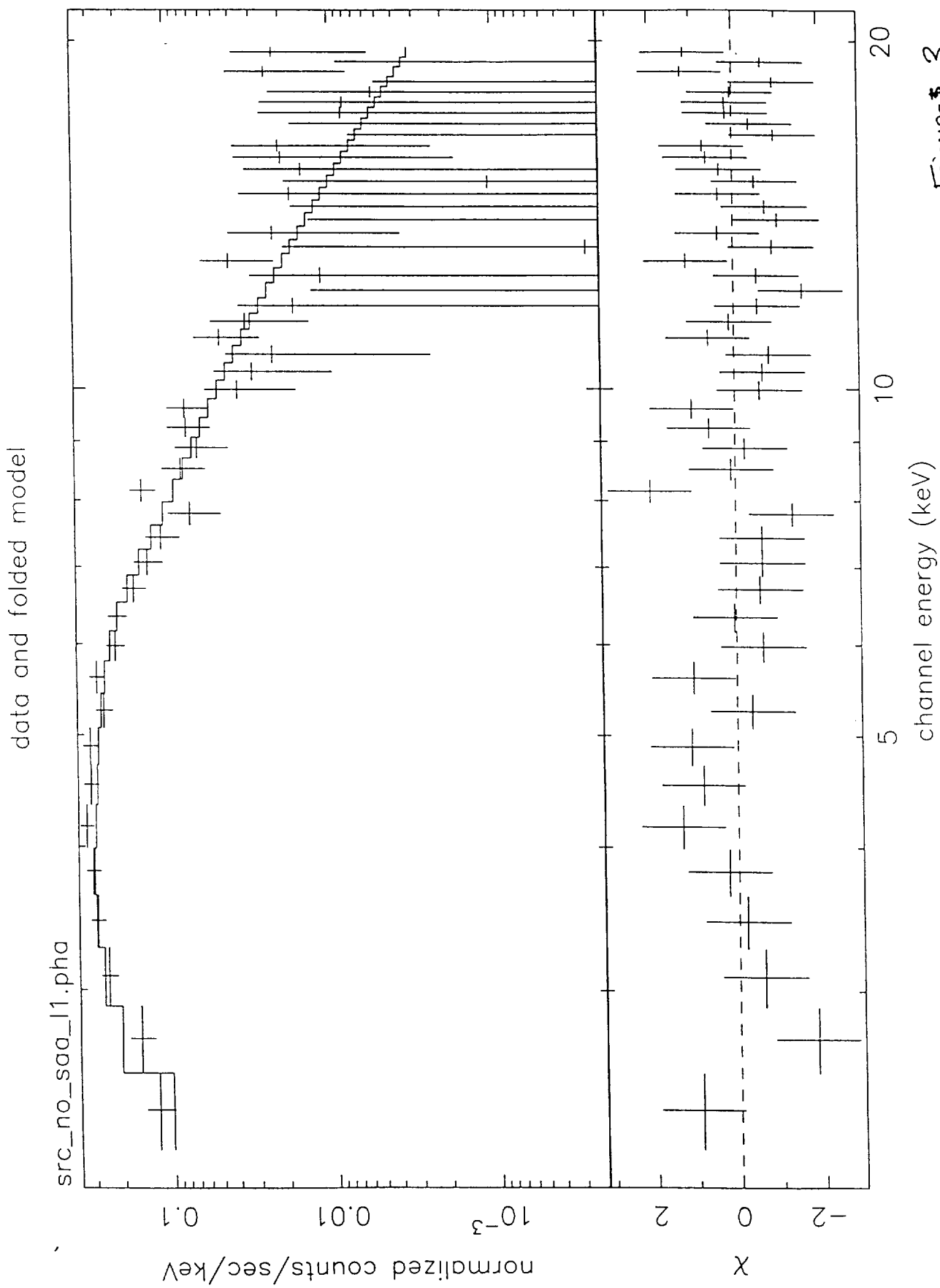


Figure 3